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Abstract

BRADWELL NUCLEAR POWER STATION – COMPARISON OF SHIELDING PERFORMANCE WITH DESIGN CALCULATIONS

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1. The results of radiation measurements through the shields of the Bradwell reactors are used to test methods of calculation used in power reactor shield design. The methods used in the U.K., based on a combination of removal and age–diffusion theory, have been developed by the U.K.A.E.A. (Winfrith) Shielding Group and tested using slab shields of simple configuration. However, to treat the effects of complex geometry found in the shields of large power reactors, various extensions to these methods of calculation are necessary and it is the purpose of this paper to test the modified methods by comparing the results of calculation with experimental measurements.

2. Measurements of thermal neutron reaction rates were made using manganese–nickel alloy foils. Fast neutron reaction rates were measured with pellets and blocks of sulphur and gamma dose rates with condenser ion chambers. Results are reported for measurements of:

(a) fast and thermal neutron reaction rates through the side and top reflectors and pressure vessel,

(b) fast and thermal neutron reaction rates and gamma dose rates through the side and top biological shields,

(c) thermal neutron reaction rates in the thermal column

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3. The modified methods of calculation for the side and top Bradwell shields are described in detail, particular attention being paid to the treatment of shield layers which do not approximate to uniform slabs of material. An example of this is provided by the top shield where the reflector and chargepans are pierced by the fuel channels, enabling fission neutrons to stream directly from the fuel elements into the pressure vessel and top biological shield.

4. The measured and calculated reaction rates agree to within a factor of 2, over attentuations of 7 or 8 decades. Thus it is shown that the methods of calculation developed for systems with simple geometry may be extended so as to apply to the complex shield configurations of large power reactors.